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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/585,245	01/10/2007	Yasuhiko Kasama	8075-1099	9603

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EXAMINER	
PADGETT, MARIANNE L	

ART UNIT	PAPER NUMBER
1792	

NOTIFICATION DATE	DELIVERY MODE
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

DocketingDept@young-thompson.com

Office Action Summary	Application No.	Applicant(s)	
	10/585,245	KASAMA ET AL.	
	Examiner	Art Unit	
	MARIANNE L. PADGETT	1792	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE _3_ MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on _7/5/06, 1/10/07 & 9/25/09_.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) _1-21_ is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) _1-21_ is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☒ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _7/5/6, 9/25/9_.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

1. Applicants' **information disclosure** (IDS) of 9/25/2009 has been made of record, however none of the references of the IDS of 7/5/2006, filed with the PCT/371 papers are present in the scanned file, hence these references are not appropriately available in the scanned file for review by the examiner, hence the 7/5/2006 PTO-1449 has been X-ed out. The examiner attempted to retrieve all these references from the JPO web site, however the first 3 did not appear to correspond to any numbers that may be retrieved from that site, but the examiner has provided the last two & machine translations thereof, plus a machine translations of the JP reference cited 9/29/2009.

The examiner notes that the PCT search report indicates that JP 2920188 B1 from Nissin Electric Co., LTD is an X reference for claims 1-3, 11 & 17, plus is a Y reference for claims 4-10, 12-13, 15, 16 & 18-21, with relevance to claim 14, however as this reference is not available to the examiner, it cannot be evaluated with respect to the claims presented in this related US application, nor can the relevance in combination therewith of the other 5 listed Y references.

The examiner notes that applicants' PCT priority documents were found in the scanned file, however no certified copy of the original Japanese priority document appears to be present.

2. **Claims 1-21** are rejected under 35 U.S.C. **112, second** paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In the claims, applicants use "**implantation target**" as adjectives describing "ions" (i.e. "implantation target ions"), however it is uncertain whether this description is actually supposed to provide any limiting conditions with respect to the ions that are implanted by the process, or if they are only excess verbiage. For instance, is "target" describing a source of the ions, or merely indicating that the ions are targeted at the substrate, which is also required by the "implanting..." step? For examination with respect to prior art, the broadest possible meaning will be considered, i.e. that "implantation target" is merely language identifying an arbitrary group of ions used in the subsequent implanting, but provides

no necessary further meaning. If this is applicant's intent, they may merely indicate so on the record. If something more is intended, clarification of the claim language/limitation is needed.

Similarly but more significantly, it is uncertain in what way "**deposition-assistance**" is intended to modify "substrate", since this terminology used as an adjective implies that the substrate in some way assists the deposition of something, where neither what deposition nor when is specified, but it could alternatively mean that the substrate is somehow actively involved in the deposition of "a material film" or even in the "implanting the... ions", as "assistance" implies something more active than the passive participation that a generic substrate plays in any deposition on or implantation into its surface. <u>Alternativel</u>y, the "deposition-assistance" could be a future use of the substrate after processed by the steps of the method (i.e. intended enduse); <u>or alternatively </u>it could be essentially meaningless verbose adjectives that provide no further limitation to the generic substrate. As presently written there is no way to determine if any of these possible intended meanings are correct, or if something else was intended.

In independent **claim 1**, the step of "giving acceleration energies to the... ions by a bias voltage **applied by** the deposition-assistance substrate" (emphasis added) appears to be nonidiomatic English, since this phrasing means that the bias voltage comes from the substrate, as opposed to being -- applied **<u>to</u>** the substrate --, which is how one frequently causes of ions to be accelerated towards a substrate.

In dependent **claim 5**, exactly what has been required to be repeated is not quite clear, since "a step of depositing a material film on the deposition-assistance substrate" does not use an article showing antecedent basis to the "a material film" introduced in the independent claim, but neither is the dependent claim limitation differentiated therefrom, plus is required also to be "on the deposition-assistance substrate", hence it is uncertain whether this limitation is intended to require the process of claim 1 to be repeated on different parts of the substrate, or is forming a multilayered structure with multiple deposited films stacked on each other or on opposite sides of the substrate, where the film at material may or may not be the same; or is performed on multiple substrates, as applicants appear to consider plural but

separate plates (e.g. claim 14) to be a substrate, but such is essentially a description of multiple substrates. The present phrasing is ambiguous, however any possible meanings may be considered with respect to the prior art.

In **claim 6**, the requirement that "the ions are implanted into the material film comprising fullerene to produce containing-fullerene or hetero-fullerene", is vague, indefinite & confusing, since what is produced is not clearly stated, i.e. what is meant by "to produce containing-fullerene"? The phrasing of this claim appears to indicate that the "film material" already contains "fullerene", where it may be some or all of its composition, thus it is already "containing-fullerene", so nothing is actually necessarily produced. If something else is intended, it cannot be determined from the present claim language. It is noted that "hetero", as a description of fullerene, is discussed in [0115] on page 54 of the original specification to mean any fullerene molecule where one or a plurality of the carbon atom(s) in the molecule are substituted by atom(s) other than carbon, with examples having nitrogen or boron substitution mentioned, however this would appear to simply be a species of fullerene, which has already encompassed by the original condition of the "material film **comprising** fullerene".

In **claim 9**, use of an undefined abbreviation or acronym, "EL" is improper, as for clarity of meaning such terms should be written out in full on the first time they are employed in a claim sequence. Furthermore, if the examiner's guess that EL = electroluminescent is correct, it is uncertain whether "a film material of organic EL" is intended to mean an organic electroluminescent material, or any material that may be employed in an electroluminescent film composition, in the latter case the scope of what such material maybe is unclear. Similarly, it is unclear whether "a material of solar cell" is intended to mean any material which might be used in any solar cell structure that has ever been produced, or if it is intended to mean a material with a particular function of the solar cell. The same confusion or lack of clarity is present in the option of "a material film of fuel cell".

In **claim 14**, it is uncertain if applicants are claiming that the singular "the deposition-assistance substrate" is actually a composite structure made of plural plates that fit together in a concentric circle (i.e. plural substrates), or as literally claimed in plural "concentric circle shapes", which means they must sit together in multiple circles, or if applicants are using extremely cryptic and nonidiomatic phrasing to claim plural substrates that are circular plates concentrically arranged, or something else entirely. Also, what is meant by "deposition-oriented plates" is unclear & ambiguous. Do the plates cause some sort of "oriented" deposition such as epitaxial, or is the intended merely to say that the plates are oriented such that deposition can occur on them (as one would expect any substrate to be on which a deposition is intended), or what?

Claim 15, states "the... ions are implanted, by cooling the deposition-assistance substrate by cooling means", but it is unclear how the act of "cooling" of the substrate causes ion implantation to occur as claimed, as cooling generally is not a means of causing implantation or diffusion into any substrate, let alone all generic possible substrates. Is the meaning of this claim unclear due to poor translation, such that something more common, such as requiring cooling during ion implantation was intended? The examiner notes such procedures are commonly employed, dependent on whether the substrate or some material of a composite substrate being ion implanted are sensitive to overheating due to energy transfer from impacting ions.

In **claim 18**, it is required that "said deposition-assistance substrate comprises a conveyor or rotary cylinder", however a substrate on which a coating is applied is not part of an apparatus, thus further describing the substrate to be some unspecified shape capable of conveying some unspecified something else, or being a rotary cylinder, while it may imply possibly that the apparatus should have some means of holding a substrate of the shape, it does not clearly do so, thus it is not clear how claim 18 further limits the apparatus claims. <u>Alternatively</u>, since conveyors & rotary cylinders are types of apparatus means frequently employed as holders or used with holders or to transport substrates, this language confusingly

suggests that this claim they suffer from translation problems, so as not to clearly set forth the intended meaning, especially when considering subsequent claim 19, which does claim options as in claim 18 for support & transport of substrates, but not as the substrates themselves.

Note in **claim 19**, line 6, that for "said deposition-assistant substrate**s**" (emphasis added) to properly have antecedent basis from independent claim 16, it needs to be singular, as only the singular was introduced in independent claim 16. As presently written, it is uncertain whether applicants' claimed transport device is configured to transport a plurality of plural substrates, or merely plural substrates, as the antecedent basis is to a singular additional limitation, but the actual term is plural.

While applicants will need to consider appropriate language in **claim 20**, depending on how they amend claim 19, it is further noted that the language "... **supported to** said transport device by an electroconductive clamp member" (emphasis added) is non-idiomatic English. Do applicants intend the substrates to be -- supported **by** said transport device... --?

3. Some matters with respect to **scope**.

Note in the two independent apparatus **claims 16 & 17**, that no substrate holder or means for holding the substrate are necessarily required by the claim language, since "a deposition-assistance substrate arranged within said vacuum vessel" is a method limitation, which does not actually require any substrate holder or any means for holding the substrate, however what ever apparatus is considered, must be capable for having the substrate arranged in some unspecified fashion within the vacuum vessel at some time.

It is further noted that applicants have employed the language "... **means for**..." for most of the limitations of their apparatus claims, however the examiner observes that "plasma generation means for generating plasma at least including... ions and charged particles...." requires the plasma generation means to effect specific results, such that this limitation need not be considered with respect to 112, 6th paragraph as meaning specific plasma generation means disclosed in the specification, although the

examiner notes that the required characteristics of the plasma recited in the independent apparatus or method claims, are merely inherent characteristics of all plasmas, which will be a mixture including ion species, negative & positive, plus electrons, all of which are charged particles, as well as including various neutral species.

However, the limitations of "bias voltage application **means for** applying a bias voltage to said deposition-assistance substrate" (emphasis added, **claims 16 & 17**), and "material film deposition **means for** depositing a material film on to said deposition-assistance substrate" (**claim 16**) both have proper 112, 6th paragraph phrasing, such that this claim language indicates their scope is defined by particular means or their equivalents as set forth in the specification. The examiner notes that figures 1-7, 9 & 12b have configuration showing implantation apparatus &/or substrate configuration being implanted, which include symbology indicating voltage applied by either DC current (high-voltage) connected ground or RF frequency (AC or H.F.) connected ground. In applicants' Jumbo's specification, the examiner notes that figure 7 shows ref #144 & #149, described on page 42 as being "alkali metal sublimation oven 144", whose vapor is ionized by hot plate 146, & on page 45 as being a "fullerene sublimation of oven 149", respectively, the latter of which appears to be the means for depositing a fullerene film, although the paragraph [0092] also uses the nonidiomatic "containing- fullerene" nomenclature, improperly standing by itself, without telling what it is appropriately describing. Figure 3, illustrates ref. #82, & figure 2a or 1a, ref.#54 or ref. #4 &8, respectively, also appear to be indicating sublimation ovens ([0067] on page 33, [0054 & 56] on page 28)

Also, the language of dependent **claim 21** requiring "cooling **means for** cooling said deposition-assistance substrate" also invokes 112, 6th paragraph. The examiner notes depiction of cooling means in figures 9(a & b), as ref.#'s 176, & 186, with [0103] describing this means on page 50 as being "a cooling water circulation apparatus", which is noted to prevent plastic substrate deformation & degradation due to heating during ion implantation.

4. The **disclosure** is **objected** to because of the following informalities: on **page 41**, in [0082], "prove" in the phrase "a Langmuir **prove** as means for measuring.... flowing through the **prove** by a **prove** electric current " appears to be a typographical error, since "prove" is a verb, the word is being used as a noun in a context, which suggests to the examiner that maybe -- probe -- was intended.

Further proofreading is recommended, as this is not a complete listing.

Appropriate correction is required.

5. The following is a quotation of the appropriate paragraphs of **35 U.S.C. 102** that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

It at The following is a quotation of **35 U.S.C. 103(a)** which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

The **nonstatutory double patenting rejection** is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the “right to exclude” granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct

from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

6. **Claims 1-5, 9 & 16-17** are rejected under 35 U.S.C. **102(b)** as being clearly anticipated by **Miyake Koji et al**. (JP 2000-012285).

Claims 10-11, 14 & 18-20 are rejected under 35 U.S.C. **103(a)** as being unpatentable over **Miyake Koji et al**. (JP 2000-012285).

Miyake Koji et al. (English abstract & figures 3-8) teach ion implanting negative hydrogen ions into a substrate, which as illustrated in figure 8 is a coated substrate, where the plasma is taught to contact the substrate, with the apparatus of drawings 4-7 providing examples of different magnetic field (B) influences employed in various plasma processes process, all contacting (e.g. transporting the plasma on to substrate) the substrate with plasma, where the examiner notes that the electric coil 105 illustrated in drawing 7 would inherently create growth magnetic & electric fields while voltage has passed therethrough. Note that generically, any gas inlet is a means capable of supplying deposition material & that implanting a surface of a substrate creates a surface film, thus all Koji et al.'s apparatus options fits the *generic* meaning of the present apparatus claims deposition means.

A **machine translation** of **Koji et al**. is provided by the examiner, which provides further discussion supportive of the English abstract and describing examples employed the figures, however the examiner notes various this translations or misnomers, where it appears that implants, implanted & implanting have been mistranslated as "pores", "poured" & "pouring"; while translations stating "putting

out the lights" appears to be used in a context which would mean -- turn off --; "point light state" appears to be being -- on state -- or -- turned on --; and "hydrogen content child" or "...children" appears to mean -- H_2 dissociation products or species -- or the like. This is not a complete listing of machine translation problems, but should make the reference easier to follow.

Particularly note drawing 4 is discussed on [0060+] with respect to Ex. 2, and has magnetic field influences from both permanent magnet 71 & conductive bar structure 69, such that the plasma that flows through the bar structure to the wafer 72 substrate, excludes the high-energy electrons, but not the low energy electrons, thus influencing the plasma flow. The plasma is formed using hot filament 64, and the substrate is positively biased with power source 77, where both of plasma and bias are pulsed as shown in drawing 3 discussed in [0052-58]. It is noted that all of the examples & apparatus are discussed with respect to pulsing as illustrated in drawing 3. Drawing 5 is discussed in Ex. 3 in [0073]; drawing 6 in Ex. 4 in [0074+], while Ex. 5 discusses drawing 7 in [0077+], with the H^- ion implantation process that may be performed by any of this apparatus, as illustrated in figure 8(1) discussed on [0084+].

Example 5 employs cesium vapor from oven 117 directed at target electrode 101, which is involved in a sputtering process with hydrogen and rare gases (Xe), so as to control the hydrogen ion charge species, where [0083] notes that Cs is deposited or shallowly implanted on the substrate surface, which even though for their specific process it is intended to be later removed, it still constitutes a deposition during processing, hence simultaneously with the overall ion implantation process, where since the process is also pulsed, the entire process implantation & deposition may be considered to be repeated with each pulse cycle. Note that the oven vapor supply structure of drawing 7 is consistent with applicants' apparent 112, 6th paragraph meaning with respect to "material film deposition means for..."

While Koji et al.'s process is primarily directed to pulsed bias means for H^- ion implantation, with the ion implantation technique's specific use in creating silicon-on-insulator (SOI) structures, mention is

made in [0009] of such structures usefulness with respect to solar cells, thus layers formed & deposited in the process are considered to include "a material film of solar cell".

While Koji et al. does not appear to teach specific ranges of acceleration energies (i.e. implantation energies) for their hydrogen ions (or Cs ions) that may be implanted via their process, nor discuss the parameter of ionic current density, it would've been obvious to & reasonably expected for one of ordinary skill in the art to optimize acceleration energy & ionic current density dependent on desired depth of ion implantation & desired dose, in combination with other plasma parameters which affect these results, since acceleration energy = implantation energy of a particular ion species when impinging on a particular substrate material will provide characteristic implantation depths, which may also be modified by parameters such as substrate temperature. It is further noted that as applicants' claims are silent with respect to types of ions, & mostly vague with respect to specific materials being implanted (claim 9), etc., the claims lack sufficient context to provide significance to specific implantation parameters.

With respect to batch processing of plural substrates versus the single substrate discussed in the examples of Koji et al., configuring apparatus for batch processing versus single substrate is an obvious variation in processing, old and well-known to those of ordinary skill in the art and desirable to employ for mass production purposes, thus an obvious variation on the teachings of Koji et al., especially considering discussion of the above process that makes scanning of ions to be implanted across a substrate unnecessary ([0030], [0034-36], etc.). Hence, whether a batch of plural substrates are mounted on a conventional planetary (rotating) support for multiple substrates, where each substrate may be rotated into the plasma zone, <u>or</u> multiple substrates are treated simultaneously, it would've been obvious to one of ordinary skill in the art for the biasing of the specific substrate to be individually controlled, since in either case it is only the substrate that is desired to be ion bombarded & implanted, not surrounding holder structure, which if extensively ion bombarded could produce sputtering contamination in the chamber &/or cause harm to the structure itself. Thus, it would've been reasonable for a competent

practitioner to selectively direct the ion bombardment, hence the biasing to only the (those) substrate(s) being implanted at that time & only biasing the substrates themselves. Also note that such rotate a full substrate holding platforms may conventionally be disk shaped, which is a very short or thin cylindrical shape.

While Koji et al. does not discuss specific holding means employed in securing substrates two substrate holders, such as the claimed "electroconductive clamp member", it is old and well-known to employ electrostatic clamping structures with silicon substrates as contemplated to be treated by the process of Koji et al., hence it would've been obvious to one of ordinary skill in the art to use such conventionally employed structures in any of the apparatus as depicted by Koji et al., as they would have reasonably been expected to perform their standard function with respect to typically electrostatically clamped substrates, where the examiner additionally notes that any electro-static clamping structure will necessarily have something that may be called ‘an electroconductive clamp member’.

7. **Claims 12-13 & 21** are rejected under 35 U.S.C. **103(a)** as being unpatentable over **Miyake Koji et al**. (JP 2000-012285), as applied to claims 1-5, 9-11, 14 & 16- 20 above, and further in view of **Yamashita Mutsuo** (JP 2003-313662).

Koji et al. does not discuss in apparatus employing a grid electrode to control the plasma potential, where such a grid electrode is separately positioned from the substrate, however **Yamashita Mutsuo**, who teaches a sputtering apparatus (drawing 1, [0026-38] in machine translation) substantially similar to the apparatus of Koji et al.'s drawing 7, except that it additionally employs a grid electrode 4 ([0030], also illustrated in drawings 2, 3 & 4), which grid electrode is also called a plasma grid shield, and is used to increase the plasma density during plasma generation with the high-frequency antenna coil 3, and is used for controlling the energy of ionized particles directed at substrate 5, hence it would've been obvious to one of ordinary skill in the art that the grid electrode as illustrated in Yamashita Mutsuo is an effective tool for providing additional control of the plasma conditions, i.e. plasma potential, of the

analogous plasmas directed towards substrates, particularly sputter apparatus configuration employed in Koji et al.'s drawing 7, especially considering that one of ordinary skill in the art would reasonably have desired the maximum control & versatility with respect to ion energy, plasma conditions & direction of ions into the substrate, for ion implantation as taught, thus the mesh grid electrode 4 would have reasonably been expected to supply such additional control given the effects discussed as provided thereby by Yamashita Mutsuo. The examiner further notes that any time that the plasma is generated, a voltage potential will be thus applied (e.g. floating potential induced by the plasma) to the electric grid, or alternatively, dependent on optimization, it would've been further obvious to one of ordinary skill in the art to apply specific voltages to the grid dependent on desired degree of effect the grid is to have on the plasma as a whole & specific negative or positive charged species therein. Specific distance of the grid electrode from the substrate would reasonably have been expected to depend on overall dimensions of the chamber, of the plasma zone, of the substrate, as well as specific substrate configuration, etc., however the distance would also reasonably have been expected to be sufficiently close in order to have the taught effects both on raising the plasma density of the plasma produced between it and the target electrode, and close enough to substrate to provide the control of the ionized particle energy of those particles on their way to the substrate, which reasonably would have been expected to be inclusive of distances in the claimed range of 1-50 mm.

It is noted that Yamashita Mutsuo also discuss water cooling of structures in their plasma chamber on which the plasma impinges, specifically targets 2 & 10 ([0028] & [0032]), demonstrating that it is known to employ cooling mechanisms on structures exposed in the plasma which may be detrimentally affected if the plasma induces excessive heating thereof, hence dependent on specific materials employed for electrodes or substrates, with further consideration of the desired effects of implantation to be produced in the substrates, it would've been obvious to one of ordinary skill in the art to provide means for temperature control in order to prevent damage or to further desired development of

microstructure, where such temperature control would reasonably have been expected by one of ordinary skill in the art to encompass either heating or cooling mechanisms, where cooling would have reasonably been expected to be more frequently employed when substrates are more sensitive to damage by high temperatures, which might be induced by ion bombardment.

8. **Claims 6-8 & 15** are rejected under 35 U.S.C. **103(a)** as being unpatentable over **Miyake Koji et al**. (JP 2000-012285), as applied to claims 1-5, 9-11, 14 & 16- 20 above, and further in view of **Watanabe Satoshi et al**. (2002-255518).

Koji et al. while specifically discussing ion implantation with respect to semiconductor substrates or also with mention of metal or insulators substrates (abstract; claim 1; [0001]; etc.), does not particularly discuss ion implantation of a substrate or a coating that it may comprise fullerene, however **Watanabe Satoshi et al**. (English abstract; drawing 1; [0001]; & [0006-8]) provide teachings which indicate that it is desirable & known to employ ion implantation techniques on substrates have been paper deposited coating of fullerene thereon, in order to provide implantation of specific ion in the fullerene compound. Satoshi et al. employs an ion injector with mass spectrometry magnets, as illustrated in their drawing, which ion implantation equipment is analogous to the prior art ion implantation techniques discussed by Koji et al. with respect to their drawing 1, which techniques their process provides improvements thereover, as it is not necessary to scan the entire surface in order to treat the entire surface, hence it would've been obvious to one of ordinary skill in the art to employ plasma apparatus as illustrated in Koji et al.'s drawings, especially drawings 2-4, as they provide the ability to control on an implantation as taught by Koji et al. which would reasonably have been expected to be effective for other specific substrates than those particular demonstrated, such as Satoshi et al.'s fullerene coated substrates, with the additive vantage of not needing to scan the entire surface in order to treat the entire surface. It would have been further obvious to one of ordinary skill in the art that as fullerenes are complex molecules whose structure may be disrupted chemically at sufficiently high temperatures, to control the

substrate temperature during ion implantation, so as to maintain a desirable temperature, where temperature maintenance would reasonably have encompassed substrate temperature control means inclusive of old & well-known cooling techniques, such as thermally conductive means using heat transfer media, like as water.

9. **Claims 1-6, 9, 11 & 16-18** are rejected under 35 U.S.C. **102(b)** as being clearly anticipated by **Hirata et al**. (The K^+-C^-_{60} Plasma for Material Processing").

Claims 7-8, 10, 14 & 18- 19 are rejected under 35 U.S.C. **103(a)** as being unpatentable over **Hirata et al**. (The K^+-C^-_{60} Plasma for Material Processing").

Hirata et al. (abstract; figures, esp. 1-6; last ¶ of Introduction on p. 288; Conclusions p. 292) teach a plasma source having a K^+ plasma column confined by a strong axial magnetic field, into which Buckminster fullerene particles are injected, such that large negative C^-_{60} ions deposit on substrates, while being bombarded by potassium ions, to form conductive deposits of K-C_{60} compound, which may be considered to be a coating of fullerene implanted with potassium. Hirata et al. suggest that such C_{60} based films usefulness in functioning as alkali fullerides & polymers, where the examiner notes that fullerene compounds are generally conductive & due to their highly cross-linked structure, considered a species of polymer. Hirata et al. teach 5 substrates on a translatable substrate holder, where each substrate's bias voltage may have individually controllable external biasing applied thereto (figure 1; ¶ bridging p. 289-290; 1st col., p. 91), where tests using applied voltages include negative voltages (e.g. -10 V) applied to the substrate (figures 3 & 5). Hirata et al. measure various plasma ion density is with a Langmuir probe, including electron, K^+, C^-_{60} densities (1st ¶ experimental results on p. 290, & figure 2), where I_{s+} indicates the positive saturation current, thus in figure 2 the bottom right hand curve indicates the radial profile corresponding to the ion current density of potassium, which given the scale of 0.4 μA, gives a peak height of approximately 1.2 μA, so is reasonably considered to correspond to applicants' 1 μA/cm^2 or more for the radial profiles. The energy (temperature) of the potassium ions in the plasma of this

experiment is taught to be about 0.2 eV, which while not said to be the acceleration energy, would appear to be related thereto, with a noted that the value is lower than 0.5 eV of applicants' claimed range of 0.5-500 eV, is not significantly different therefrom 0.5 eV, especially considering Hirata et al. conclude that their "results demonstrate that fullerene-based materials such as an alkali fulleride are produced by controlling the incident fluxes and energies of alkali and fullerene ions at biased substrates" (page 292, end of 1st col.). Henc, e it would've been obvious to one of ordinary skill in the art to employ different energy ranges, i.e. accelerations, for the positive ion (e.g. K or the like), with variation for particular substrate biasing voltages, using routine experimentation to optimize for different parameter variations, which would reasonably also been dependent on particular positive ion employed, as well as particular fullerene compound deposited. With consideration of employing other alkali metals than the particularly exemplified potassium, as well as different fullerene compounds, which combinations would reasonably have been expected to have different useful ranges of optimization, so applicants' alternative ranges of 10-500 eV & 20-500 eV, would also have reasonably been considered to be within the bounds of useful acceleration energies, especially considering ions of different masses very in their ability to penetrate a like substrate material, thus would have been expected to have different optimized energy requirements.

Note that in the teachings of Hirata et al., deposition of the fullerene compound is occurring simultaneously with the irradiation of the plasma that bombards the deposited fullerenes compounds with K ions, and this process is performed on a set of five substrates at a time, thus may be considered to be repeated, especially considering as appears to be indicated by applicants' claim 14, that applicants consider the equivalent of plural substrates to be one large composite substrate. Hirata et al's multiple substrate arrangement with individually controllable bias voltage structures differs from applicants' possibly claimed arrangements in that Hirata et al.'s is a linear structure, while applicants claim a configuration that might read on a concentric circle a plurality of flat substrates (i.e. "a plurality of divisional deposition-oriented plates in a concentric circle shapes"), however the Hirata et al. article's is

an experimental discussion of this technique, where their radial profiles, as illustrated in figures 5 & 2, suggests that different distances from the radial center of the plasma will produce different conductance in the deposits on the substrates, thus it would've been obvious & reasonable for one of ordinary skill in the art, when performing batch processes in the taught apparatus that are intended to be used for production purposes, rather than experimental research, to place all substrates so as to achieve equivalent plasma exposure for each surface in the plasma, hence the experimental data showing differential results with respect to radius would clearly & reasonably suggest to one of ordinary skill & competence to have the substrates concentrically placed about the axis of the plasma column &/or use of substrate movement that insures equivalent exposure, especially considering that such techniques are typical & conventional in the plasma & vapor arts. Also, it would've been obvious to one of ordinary skill the art to employ conventional means for securing substrates to substrate holders, especially if any substrate movement/substrate holder movement is involved in the process in order to insure repeatability of the process due to repeatable positioning & to avoid defects or errors due to substrates getting out of place, thus use of standard substrate securing means, such as electrostatic clamps would reasonably have been expected of a competent practitioner, as a known & effective means of providing such secure holding.

Note that as there is some question as to whether dependent claim 18 is solely directed to a method limitation, which it is not necessarily limiting to the apparatus structure (i.e. no clear difference with respect to the independent claim can be determined), <u>or</u> to an apparatus structure, that is miss-described as the substrate being treated in the apparatus, this claim has been included in both 102 & 103 rejections.

10. **Hatakeyama et al**. ("Formation of alkali- and Si-Endohedral Fullerenes Based on Plasma Technology" has teachings considerably overlapping with Hirata et al. discussed above, hence is considered equivalent &/or cumulative thereto for the above rejection.

Huang et al. ("$^{14}N@C_{60}$ Formation in Nitrogen RF-Plasma") is of interest for further plasma depositions with ions being implanted or caged within the fullerene compound, which refers to such procedures "preparing fullerene polymers" (second ¶), thus may be considered to substantiate above assertions with respect to polymers. **Watanabe et al.** ("Synthesis of Endohedral ^{133}Xe-Fullerene by Ion Implantation") provide further relevant teachings concerning both implantation of ions & fullerene dimer formation.

11. **Claims 15 & 21** are rejected under 35 U.S.C. **103(a)** as being unpatentable over **Hirata et al.**, as applied to claims 1-11, 14 & 16-20 above, and further in view of **Pietzak et al.** ("Properties of Endohedral $N@C_{60}$").

Hirata et al. do not discuss whether or not the substrate temperature is controlled, thus whether or not the substrate may be cooled, however control of substrate temperature in order to control deposition & chemical effects are standard techniques in the physical vapor deposition art, inclusive of plasma deposition techniques, which due to ion bombardment on substrates which causes energy transfer from energetic bombarding particles to the substrate, are old and well known to be temperature controlled, such as by employing cooling means to avoid overheating. Hence, it would've been obvious to one of ordinary skill in the art to employ conventional substrate cooling techniques in the apparatus &/or process of Hirata et al., dependent on temperature sensitivity of particular substrates, deposition materials or deposition processes. For example, **Pietzak et al.** (abstract; section 2, 1st ¶, p. 613; & figure 1) was also ion implanting ions in fullerene molecules that are deposited on the substrate simultaneous with the ion implantation at higher ion currents & ion energies (50 µA & 40 eV), albeit using a different apparatus set- up than Hirata et al. & implanting nitrogen ions instead of alkali metal (i.e. K); employs water cooling associated with their deposition set up as illustrated in figure 1, hence these teachings in combination with Hirata et al. would reasonably have further suggested to one of ordinary skill in the art

to employ water cooling in ion implantation procedures involving fullerene compounds, especially when higher energy implantations are performed.

Note these teachings of Pietzak et al. may additionally be considered to provide cumulative evidence for the above asserted obviousness of employing higher positive ion implantation energies.

12. **Claims 12-13** are rejected under 35 U.S.C. **103(a)** as being unpatentable over **Hirata et al.**, as applied to claims 1-11, 14 & 16-20 above, and further in view of by **Yamashita Mutsuo** (JP 2003-313662) discussed above in section 7, &/or **Hatakeyama** [et al.] ("Characteristics and Applications of Fullerene Plasmas" or "Phenomena of Steady State Discharge Plasma and Their Applications" (*formal translations requested, not yet received*)).

Hirata et al. does not discuss use of any grid electrode structured for controlling the plasma potential in their plasma column, nor its distance from the substrate, however **Yamashita Mutsuo** (discussed above) provides teachings concerning the use & effectiveness of grid electronics in controlling ion concentrations in plasma & their movement in the plasma apparatus, thus would've been obvious to employ in the apparatus & process of Hirata et al. for substantially the same reasons as discussed above in section 7. Alternatively, the **Hatakeyama** [et al.] references are both concerning plasma depositions of C_{60} ions (or allotropes thereof, e.g. carbon nanotubes) & alkali metal ions, thus are substantially analogous to Hirata et al., however only have abstract & figure captions in English, but Hatakeyama et al.'s figure 1(a) & Hatakeyama's figure 7(a) both illustrate apparatus substantially the same as that of Hirata et al., but additionally have a grid structure that may optionally (arrow symbol showing movement in or out of plasma column) be employed in the plasma column between the substrate & plasma+fullerene sources. While whether the Hatakeyama references discuss the illustrated grid as electrically charged for plasma control, cannot be determined by the examiner who does not read Japanese, the illustration & nomenclature would have suggested to one of ordinary skill in the art that such a grid is an electrically conductive grid & that when inserted into the plasma column is employed for typical & conventional

purposes of such electrically conductive grids, especially or optionally as considered in combination with **Yamashita Mutsuo**, who explicitly shows & discusses an analogous electrically conductive grid used for such plasma control purposes.

Note that Hatakeyama ("Phenomena...") provides further explanations & showings that indicate that negative substrate bias potential provides more desirable results in positive substrate potential, as indicated by the illustrations of figures 7(b) & figure 11, hence is cumulative to the Hirata et al. rejection.

13. **Claims 1-13 & 16-18** are provisionally rejected on the ground of nonstatutory **obviousness-type double patenting** as being unpatentable over claims 3-7 & 9-22 of copending Application No. **10/593,557**.

Although the conflicting claims are not identical, they are not patentably distinct from each other because Copending **10/593,557** to overlapping inventors is directed to encapsulating ions in fullerenes or nanotubes deposited on a substrate, which is equivalent to the present method claims of ion implanting deposits on the substrate that may be fullerenes (claims 6-8) or nanotubes (claim 9), where in both cases a bias voltage is applied to the substrate, which voltage is of the opposite polarity of the ions bombarding the substrate. It is noted that the preambles of copending (557) independent claims 1, 6 & 17-19 appear to describe a configuration employing a cylindrical vacuum vessel that has a plasma generation means at one end, with the substrate at the other end of the cylinder, so as to be "irradiating said plasma towards said... substrate", which while employing different semantics, is considered equivalent to the present transporting & irradiating towards requirements of the present claims, except that these independent claims do not require the use of a magnetic field to influence the transportation of the plasma, however dependent claim 7 does require such a magnetic field, hence the claims are directed to overlapping scopes of processes, with limitations claimed in different orders, thus are obvious variations on the analogous processes. Dependent claims 4 & 5 of both these cases have analogous requirements for when deposition in a radiation occurs. While the copending method claims do not recite particular acceleration energies

for ions being implanted or ion current densities therefore, it would've been obvious to one of ordinary skill in the art to optimize implantation/encapsulation parameters, dependent on specific materials being implanted & being implanted with, as well as desired results, such as limiting acceleration energy such that it is sufficient to implant structures such as the fullerenes & carbon nanotubes claimed by both applications, but insufficient to cause significant damage to the structure of these molecules during the implantation, which would reasonably have been expected to encompassed claim parameters given routine experimentation.

Copending (557) apparatus claims 13, 15, 16 & 20-22, all require a vacuum vessel, a plasma generation means, a magnetic field that must be capable of affecting transport of plasma & ions thereof towards the substrate, where a substrate biasing means capable of applying the appropriate polarity, thus are directed to apparatus of overlapping scope, you having semantics &/or method limitation capability differences that are not seen to provide any significantly different structural requirements. Also copending (557) has dependent claim 13 limitation to "said electric potential body comprises electroconductive wires in a lattice pattern", which while unclearly related to the independent claim that does not mention said body, has a descriptive structure essentially the same as the grid electrode used to control plasma potential in the present claims. As wire grids or lattices are typically & conventionally employed in the plasma art for controlling the plasma envelope, hence its potential &/or extracting particular desire to components from a plasma by judicious application of appropriate electrical potentials, i.e. voltages, given the claim of a body having electrical potential made from electroconductive wires in a lattice pattern, it would've been obvious to one of ordinary skill & competence in the art to employ such a structure for any of the typical plasma the manipulation & control procedures, such as that desired in claims 12-13 of the present application, where placement would depend on dimensions of apparatus & substrate(s), as well as particular desired results.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

14. **Claims 14-15 & 19-21** are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 3-7 & 9-22 of copending Application No. **10/593,557,** in view of **Hirata et al**., and further in view of **Pietzak et al**. ("Properties…") discussed in sections 9 & 11 above.

While these claims of copending (557) do not recite the substrate with plural divisions (e.g. plural substrates), substrate movement means, clamping means or cooling means the above discussed **Hirata et al**., in view of **Pietzak et al**. are directed to substantially analogous processes & apparatus to those claimed by these copending claims, where as seen above, plurals to substrates having possible claimed configurations, substrate movements, substrate holding means & cooling thereof, are obvious variations on known processes as described by Hirai to et al. & apparatus therefore, hence it would've been obvious for reasons as discussed above.

This is a provisional obviousness-type double patenting rejection.

15. **Claims 1-21** are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 12-22, or claims 1-33, or claims 1, 4-5, 13 & 23 of copending Application No. **10/581,441**, or, **11/659,210**, or **10/786,914**, respectively, in view of **Hirata et al**., and further in view of **Pietzak et al**. (for claims 15 & 21) or **Hatakeyama** [et al.] ("Characteristics …" or "Phenomena …" for claims 12-13), discussed in sections 9 & 11-12 above.

Copending application **(441)** differs from the present claims in that the apparatus, particularly specified to be employed for production of fullerene derivatives (method used consistent & compatible with present claims) while driving positive ions onto a substrate having fullerene deposits thereon, does not particularly specified that the substrate is negatively biased, however **Hirata et al**., as discussed above, clearly shows the advantages & desirability of such biasing in order to effect desirable positive ion

bombardment of fullerenes, such that it would've been obvious to one of ordinary skill in the art to employ such biasing means to ensure effective ion bombardment, especially given analogous intended process use. It is further noted that while copending (441) discusses employing coils for generating mirror fields which control the positive ions in the plasma, the claims do not explicitly discuss use of magnetic fields, however mirror fields & coils used to produce them, are inherently employing magnetic fields, thus mirror fields & magnetic fields are limitations having overlapping scope, thus obvious variations.

Copending application **(201)** differs from the present claims in that the method, particularly specified to be employed for production of "induction" fullerenes (i.e. implanting, encapsulating, caging, injecting, etc. atoms or ions of other elements into the fullerene structure -- methods of use consistent & compatible with present claims) while driving positive ions onto a oppositely biased substrate having fullerene deposits from negative fullerene ions thereon, does not particularly specified employing a magnetic field during the plasma deposition process, however the apparatus claims do require use of magnetic field generating means (depending claim 13), hence considering this & **Hirata et al**., as discussed above, who clearly show the advantages & desirability of such magnetic fields in order to control & transport the plasma, it would've been obvious to one of ordinary skill in the art to employ such magnetic field plasma control techniques to ensure effective ion bombardment, especially given analogous intended process use.

Copending reissue application **(914)**, while having apparatus claims directed to claimed plasma & biasing configurations that enable relevant plasma & ion transport to a susceptor electrode, capable of holding a substrate(s), copending (914) does not particularly specified employing a magnetic field during the plasma deposition process, however the apparatus claims do require use of magnetic field generating means (depending claim 13), hence considering this & **Hirata et al**., as discussed above, who clearly show the advantages & desirability of such magnetic fields in order to control & transport the plasma in

analogous plasma apparatus, it would've been obvious to one of ordinary skill in the art to employ such magnetic field plasma control techniques to ensure effective ion bombardment.

None of the claims of copending applications (441), (201) or (914), recite claimed use of an electrically conducting grid, or the substrate with plural divisions (e.g. plural substrates), substrate movement means, clamping means or cooling means the above discussed **Hirata et al.**, in view of **Hatakeyama** or **Pietzak et al**. are directed to substantially analogous processes & apparatus to those claimed by these copending claims, where as seen above conductive grids for plasma potential control, or plurals to substrates having claimed configurations, substrate movements, substrate holding means & cooling thereof, are obvious variations on known processes as described by Hirai to et al. & apparatus therefore, hence it would've been obvious for reasons as discussed above.

Also, copending claims have varying limitations with respect to ion parameters (e.g. density & acceleration energy), however above arguments concerning dependence on particular material & routine and experimentation, are also relevant here.

This is a provisional obviousness-type double patenting rejection.

16. **Other art** of interest includes: **Ueba et al**. (5,538,763), **Bhushan et al**. (5,558,903) & **Yamada et al**. (6,416,820 B1), providing further teachings on ion implantation techniques with respect to relevant materials such as fullerenes &/or carbon nanotubes; and **Buckley et al**. (2007/0243315 A1) or **Hanley et al**. (2004/0247796 A1), also using ion assisted deposition processes for relevant fullerene derivatives for electrochemical cell parts, or conductive polymers for solar cells, respectively.

17. **Any inquiry** concerning this communication or earlier communications from the examiner should be directed to **Marianne L. Padgett** whose telephone number is **(571) 272-1425**. The examiner can normally be reached on M-F from about 9:00 a.m. to 5:00 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks, can be reached at (571) 272-1423. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/Marianne L. Padgett/
Primary Examiner, Art Unit 1792

MLP/dictation software

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